SUPERRESOLUTION IN MICROLITHOGRAPHY AND FLUORESCENCE MICROSCOPY

Abstract: In scanned optical systems such as confocal laser microscopes wherein a beam of light is focused to a spot in a specimen to excite a fluorescent species or other excitable species in the spot, the effective size of the excitation is made smaller than the size of the spot by providing a beam of light of wavelength adapted to quench the excitation of the excitable species, shaping this second beam into a pattern with a central intensity minimum, and overlapping this central minimum with the central intensity maximum of the focused spot, so that within the spot the intensity of quenching light increases with distance from the center of the spot, thereby preferentially quenching excitation in the peripheral parts of the spot, and thereby reducing the effective size of the excitation and thus improving the resolution of the system. In the preferred embodiment of the present invention, the central minimum of quenching light is narrowed further by creating the pattern of quenching radiation in the specimen by imaging onto the focal plane a plurality of pairs of sources of quenching light, arrayed at the vertices of a regular, even-sided polygon, the center of which is imaged in the specimen on the central maximum of exciting radiation, and such that the two members of each pair are on opposite vertices of the polygon and emit light mutually coherent and out-of-phase, and the light emitted by different pairs is incoherent with respect to each other.